fermi

national accelerator laboratory

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SEPTUM MAGNET FIELD MEASUREMENTS

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Relative field variations across the aperture of the spare Booster magnetic septum were measured. Scans were taken at two longitudinal positions from each end of the magnet using a 2-3/4 inch coil. Observed variations are not large enough to significantly increase the beam emittance.

Equipment Setup

The magnet was driven bv one of the new S1-2 power supplies now being constructed. These power supplies provide a longer flat-topped waveform than those currently operating in the accelerator. The power supply was operated at approximately 10,000 amps. Nominal values in the accelerator are between 10,200 and 10,500 amps.

The field was measured with the 2-3/4 inch coil originally constructed for 8 GeV extraction septum field measurements. The coil was connected directly to a type "0" Techtronic Scope plug-in with an integration time constant (RC) of 1 millisecond. The output pulse of approximately 3 volts was observed as an offset scope trace with expanded sensitivity so that small variations could be observed on the screen.

Triggering was synchronized with the Main Ring and the position of the last pulse in the burst was recorded.

The coil probe was aligned perpendicular to the iron face to a few thousands of an inch over the distance of the magnet aperture.

Data

A longitudinal scan at each end of the magnet (Figs. 1 and 4) show the positions of the horizontal scans. Figs. 2, 3, 5, and 6 show the horizontal scans. The lead end scan is at the end of the magnet where the power supply leads are attached and is the beam entrance for S2 and beam exit for S1.

A comparison of Figs. 2 and 5 shows that the lead end of the magnet has a larger variation over the aperture. The reproductablility of the data in Fig. 5 is not as good as Fig. 2 because the pulse burst had only 2 or 3 pulses in it as opposed to 13.

Results

A typical injection beam has a width of about 1 cm. From Fig. 2 the variation over the beam width would be approximately 0.15% or relative to the beam center $\pm 0.075\%$. The end field scan in Figs. 3 and 6 show a larger variation but first act over a smaller distance, secondly appear to subtract from each other near the septum, and finally must be reduced by a factor of 0.6 to be relative to the higher nominal value of the deeper scans. However assuming that they add, a ±0.5% variation from Fig. 3, that is normalized to the center field and is assumed to act over 10 cm of the approximate 109 cm effective length of the magnet, gives ±0.03% as compared to the body magnet variation. Again assuming the edge effects add to the central part gives ±0.11%. The total angular bend of the septum magnet is 145 mr. Therefore the variation is ±0.6 mr across the injection beam for the worst condition. For a 10Π mmmr injection beam 1-cm width the angular height is ±2 mr. It is not believed that this effect is causing a significant problem.

Another measurement relating to leakage field was briefly tried. The field wave form with the coil at the 6-inch insertion next to the septum wall is shown in Fig. 7a. If the coil is placed just outside the wall, the waveform is shown in Fig. 7b and the variation of the peak of this waveform with distance away from the wall is shown in Fig. 7c. At the surface 8 mV out of 3600 is 0.2% of the nominal field of 3000 gauss or 7 gauss. If this field acts over 1/3 meter on the first turn around of the beam it would have a strength of approximately 2.3 gauss meters. The earths field of 0.5 gauss acting over the 6-meter long straight section of the ring is also about 3 gauss meters.

Conclusion

The effects observed appear to be small enough not to cause a measurable problem.

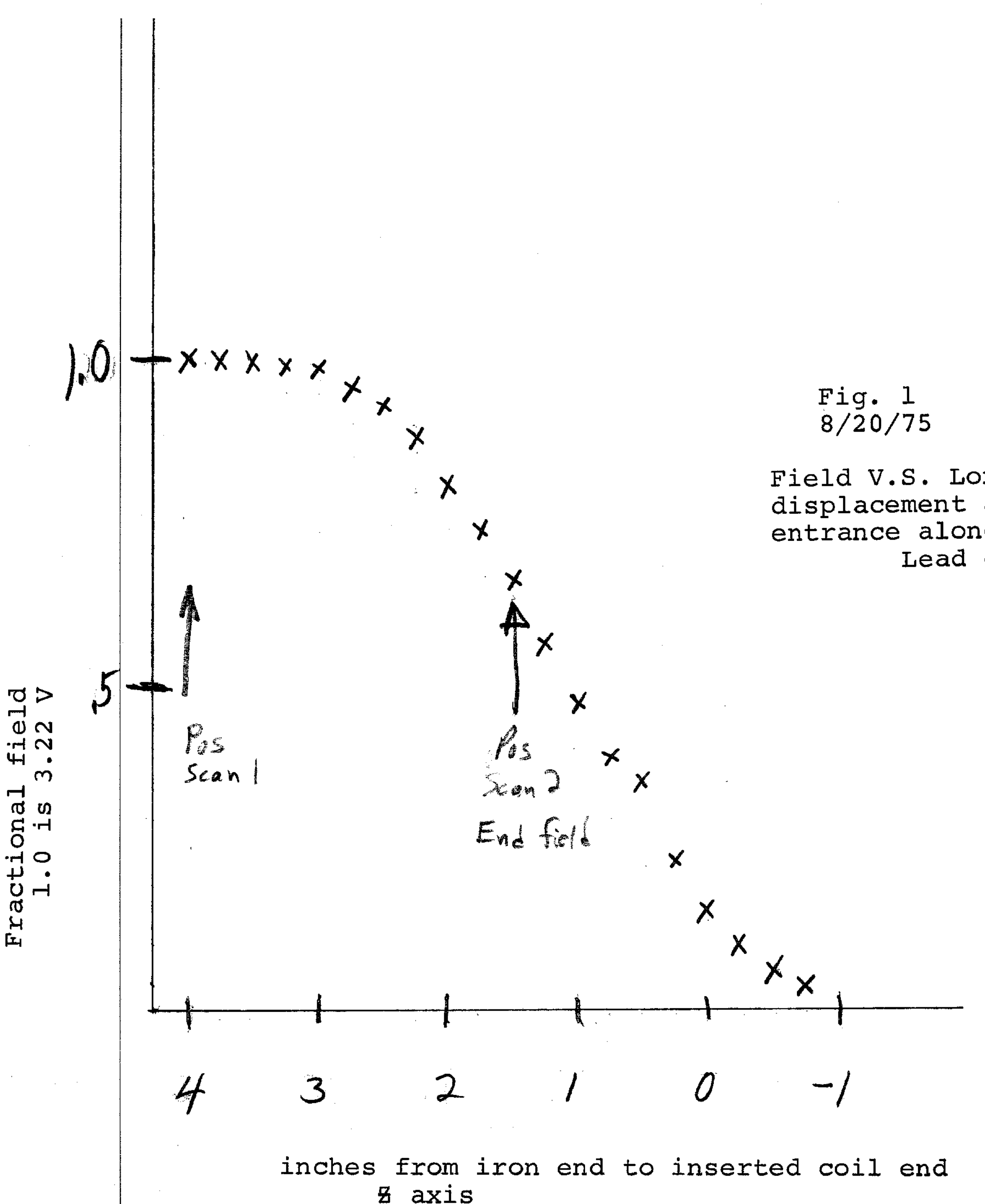


Fig. 1
8/20/75

Field V.S. Long.
displacement at magnet
entrance along Septum Wall
Lead end

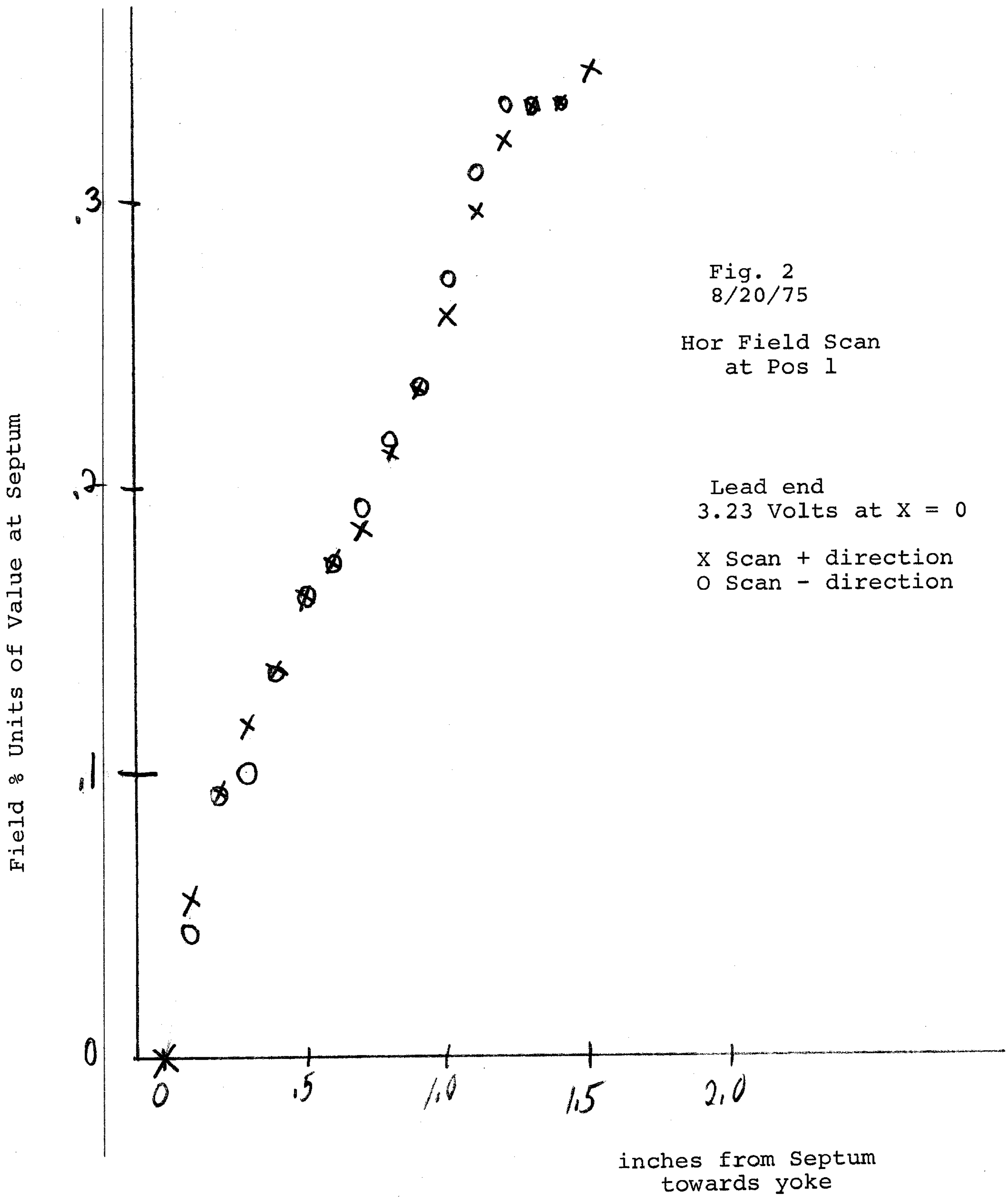


Fig. 2
8/20/75
Hor Field Scan
at Pos 1
Lead end
3.23 Volts at X = 0
X Scan + direction
O Scan - direction
Field % Units of Value at Septum
.3
.2
.1
0
0
.5
1.0
1.5
2.0
inches from Septum
towards yoke

Fig. 3
8/20/75

Hor Field Scan
at Pos 2

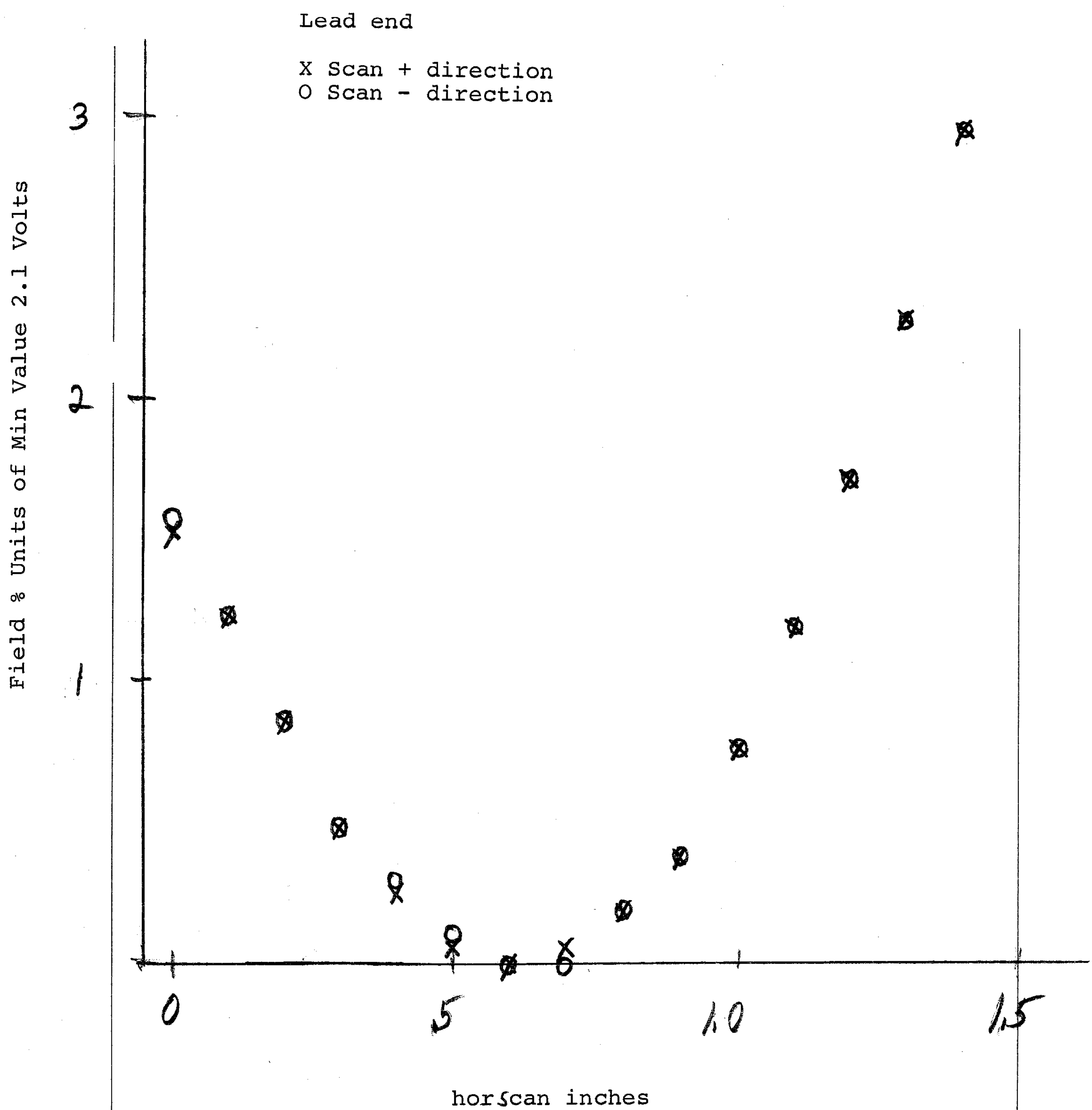
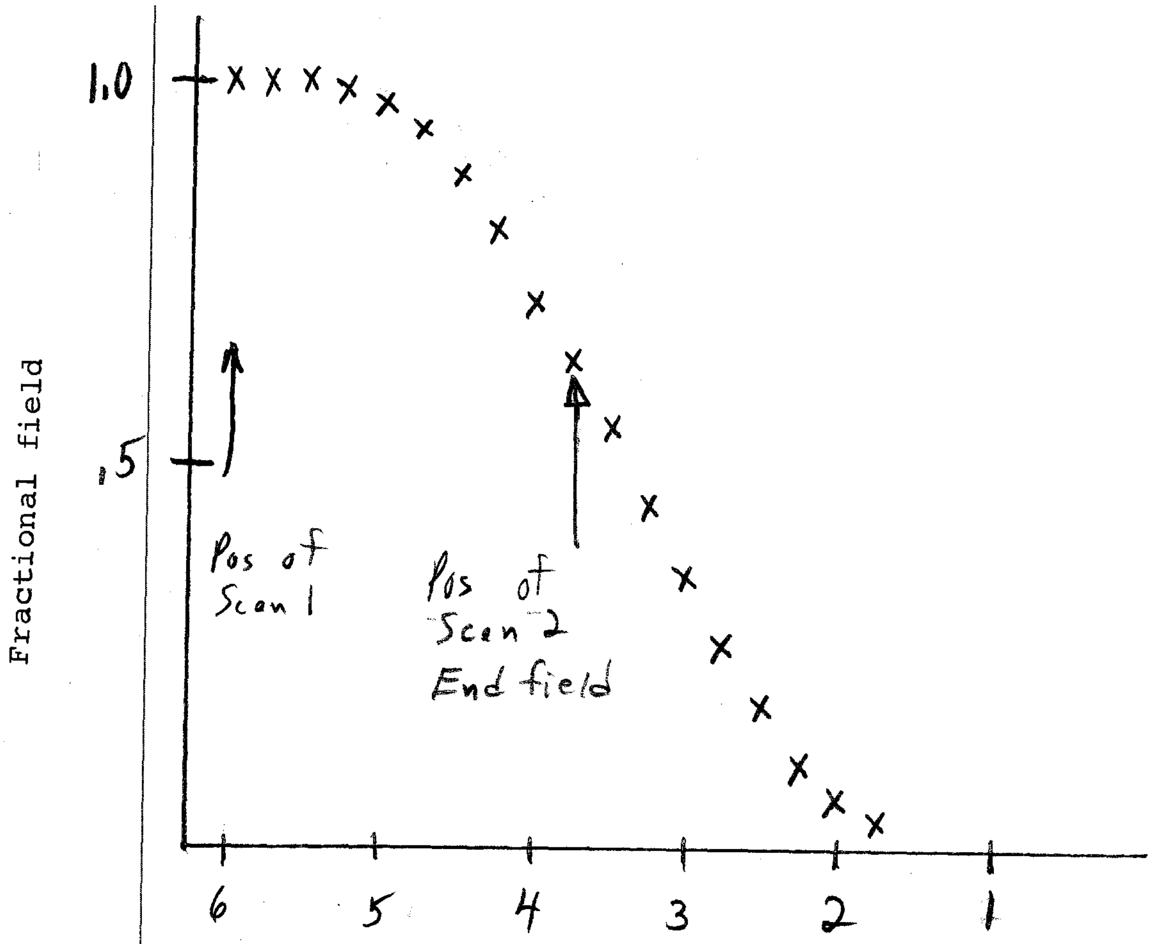


Fig. 4
8/27/75

Field V.S. long Pos
at 7 inches in from
Septum wall



inches from iron end to inserted coil end
z aris

Fig. 5
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Hor Field Scan at Pos 1

3.57 V at X = 0

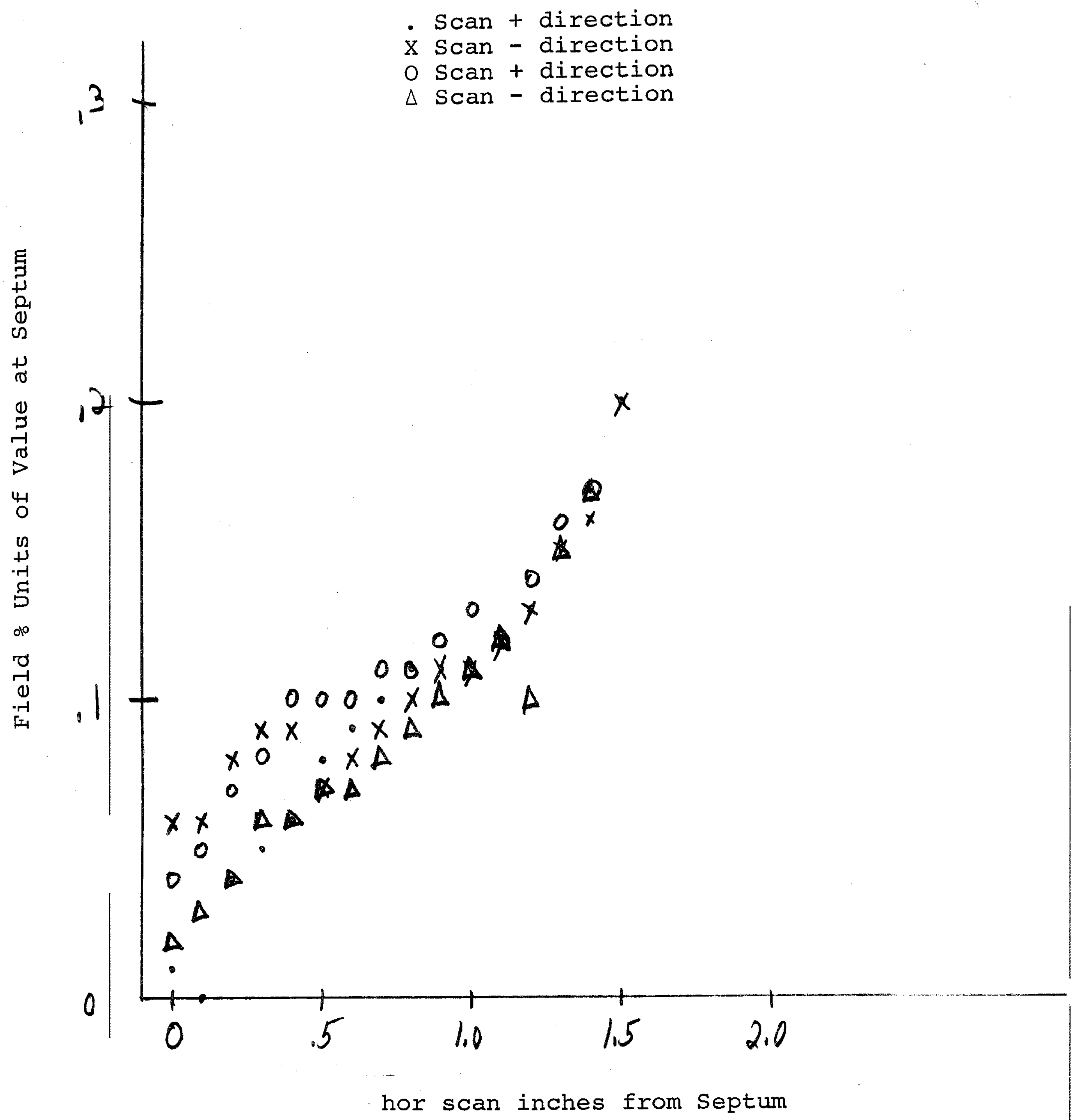


Fig. 6
8/27/75

Hor Field Scan Pos 2
End field

X Moving +X
O Moving -X

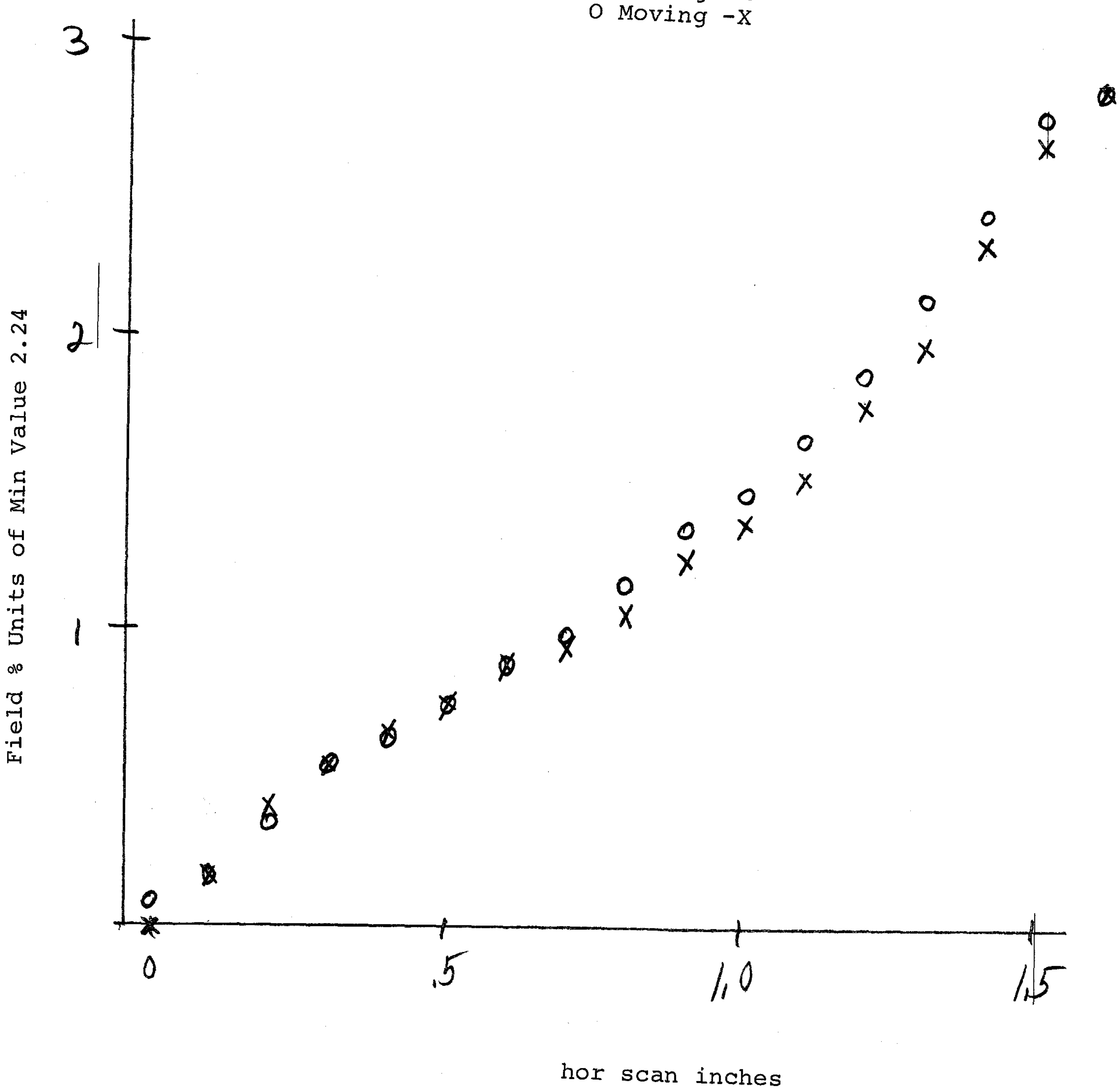
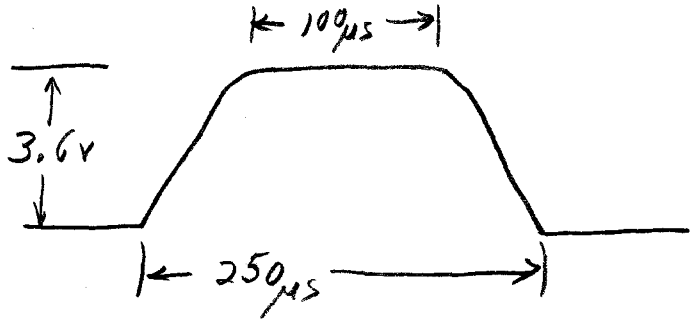


Fig. 7
9/2/75

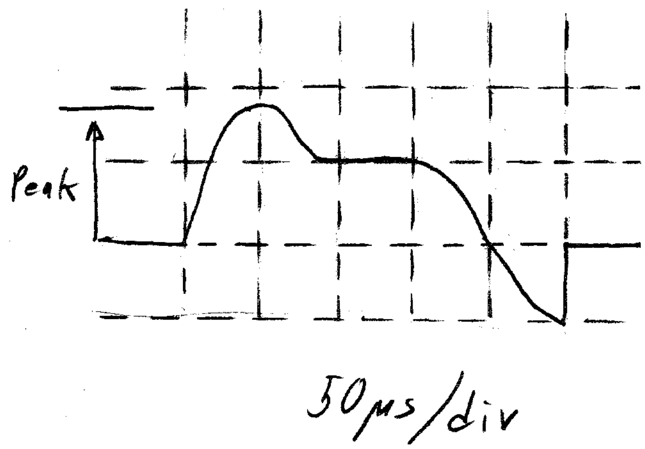
a)

Magnet Field
Waveform



b)

Leakage
Field
Waveform



c)

Leakage Peak
U.S. distance
from Septum